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(54) IMPROVEMENTS IN OR RELATING TO FRANGIBLE ELEMENTS IN SHEET MATERIAL

(71) We, COOKSON SHEET METAL DEVELOPMENTS LIMITED, of Claylands Road, Bishop's Waltham, Southampton, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sheet material, especially thin sheet material provided with a frangible element and to a method and tooling for making a frangible element in sheet material. It further relates to containers including such sheet material, and to means for the easy opening of containers. It is particularly applicable to containers made of thin sheet material, for example tinplate, in which a portion of the material bordered by a weakened line is torn by hand from a wall or end of the container.

It is the usual practice to provide a weakened line in sheet metal by scoring, that is by pressing a top die having a sharpened edge on to a flat bottom die to partially cut through the sheet metal to leave a residual of metal of about 30% of the original thickness of the material.

As the displaced metal flows from each side of the scoring tool it forms inclined surfaces in the top portion of the metal causing compression stresses which are unbalanced between the top and bottom surfaces of the metal. In consequence, the stresses induce work hardening of the residual metal below the scoring tool which inhibits the metal flow and this can give rise to incipient cracks. Because of these factors it has been found difficult to maintain a scored line with a residual of the consistent depth necessary for the ready tearability of easy open lids particularly when these are made from tinplate.

Problems in maintaining the tooling arise particularly when scoring tinplate because the edge of the scoring tool requires replacing at frequent intervals as it becomes blunted by the impact of the tool on the surface of the tinplate supported by the bottom die.

When using tinplate the scoring process is often not deemed to be satisfactory as the scoring tool cuts through the coating of tin on the sheet metal which gives rise eventually to corrosion. To overcome this problem a coating of lacquer is usually applied to the material, which is an additional expense in manufacture.

It is an object of the present invention to provide sheet material having a weakened line or weakened portion especially sheet metal with a frangible element suitable for use in a container wall. Another object is to provide a method and tooling for making a weakened line in the form of a frangible element in sheet material in such a way that it may overcome or may assist in overcoming the formation of cracks in the residual material. It is a further object to provide a method and tooling which may avoid cutting through the coating of tin in tinplate when making a weakened line.

According to one aspect of this invention there is provided sheet material having a first portion, a downward rounded formation in the top surface of the sheet leading to a frangible element comprising material of smaller thickness than the first portion, a downward rounded formation in the bottom surface of the sheet leading from the frangible element to a second portion of thickness greater than that of the frangible element, there being a hollow deformation in the second portion. Preferably the hollow deformation is an indentation in the material of substantially uniform thickness with the first portion and the second por-

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tion. The hollow deformation may be in the form of a hollow bead close to the frangible element.

Preferably the hollow deformation or bead is downwardly formed.

The width of the frangible element may exceed its thickness and the thickness of the frangible element is preferably less than one half of the thickness of the first and second portions which are of uniform thickness.

According to another aspect of this invention there is provided a method of forming a frangible element in sheet material comprising pressing a portion of the material to thin it between press tool dies in a single step pressing operation to form a first rounded formation in one surface of the material, a frangible element consisting of thinned material, the first formation joining the frangible element to a first portion of greater thickness than the frangible element, excess material from the thinned portion passing into a second portion of greater thickness than the frangible element on the other side of the frangible element from the said first portion, and a second rounded formation in the material joining the frangible element to the second portion, and simultaneously acting on the material of the second portion, without causing substantial variation of the thickness, to form a hollow indentation in the material.

In the case of sheet metal the method allows the metal from the thinned portion to be extruded and flow in the dies, and, it is believed, causes or assists in causing the compressive stresses to be equally disposed on each side of the metal and reduction in the work hardening of the metal. Excess material is caused to flow in a controlled manner from the region of the thinned portion into the said second portion to one side thereof where the sheet material is acted on by the dies to form it to the desired shape having a hollow indentation. The material in the second portion may for example be shaped to form a hollow bead close to the frangible element. Preferably the shaping in the second portion is commenced before or at least at the same time as the commencement of the pressing to a weakened line so as to initiate the formation in a controlled manner of a shape in the second region which will accommodate the extra length of material produced as a result of excess material being caused to flow from the region of the thinned portion.

Preferably the indentation is formed on the same side of the frangible element as the rounded formation which is in the same surface of the material as its inner surface.

There is further provided according to the invention a method of making a frangible element in sheet material by pressing it between press tool dies in a single step pressing operation wherein the material is acted on by the dies to displace a part of one surface of the material towards the opposite side of the sheet and to displace in the same direction a part of the other surface of the sheet, the edges of the two displaced parts being spaced from one another and being downward rounded formations, one in each surface of the material, and in the pressing operation a portion of the material between the said edges is compressed by the dies to form a thinned portion constituting the frangible element, excess material being allowed to flow into a portion to one side of the frangible element, the dies simultaneously acting on the material of the portion, without causing substantial variation in the thickness, to form a hollow indentation in the material.

The area of material which is subjected to the pressing operation may be closed in plan and the indentation may be within this area in plan. Preferably the dies produce a deformation, e.g. a bead in the metal inwardly of the pressed portion before and at the same time as the portion is pressed.

According to another aspect of this invention there is provided press tooling for forming a frangible element in sheet material including top and bottom press tool dies, having first opposed die parts having a rounded formation in one of the dies whereby sheet material pressed between the dies in a single step pressing operation has formed therein a frangible element consisting of thinned material and ajacent the frangible element on one side a rounded formation in one surface of the material, the dies being of a shape to create adjacent the frangible element on its other side a rounded formation in the other surface of the material, and of a shape to allow, during pressing of the sheet material, excess material to pass into a portion of greater thickness than the frangible element to the said other side of the frangible element, and second die parts comprising a projecting part and a recessed part which, during the pressing of the material can act upon the material of the said portion without causing substantial variation in the thickness of the material, to form an indentation in the material. The dies are formed to allow movement of excess material away from the region of the thinned portion during the pressing operation.

Preferably the projecting part is in the form of a bead, the recessed part being opposite the bead. The projecting part or bead is preferably in the same die as the said rounded formation in the first die parts.

The invention also provides a container wall of sheet material having a weakened line in the form of a frangible element according to the invention and sheet material formed by the method and by use of the

press tooling according to the invention.

One form of this invention will be described with reference to the drawings accompanying Provisional Specification No. 4248/69 in which :—

Fig. 1 illustrates in part perspective a weakened line made in sheet metal by scoring means of a type employed prior to the present invention;

Fig. 2 illustrates in part cross-section view dies for providing a scored line in sheet metal as shown in Fig. 1;

Fig. 3 illustrates in part perspective view a weakened line or frangible element in sheet metal according to the present invention;

Fig. 4 illustrates a fragmentary cross-section view dies for forming the weakened line or frangible element shown in Fig. 3, in the almost open position;

Fig. 5 illustrates in fragmentary cross-section view the dies shown in Fig. 4 in the closed position;

Fig. 6 illustrates in fragmentary cross-section view a view similar to that of Fig. 5 showing a recessed top die;

Fig. 7 illustrates in fragmentary cross-section view a shoulder reinforcing the metal adjacent a thinned portion;

Fig. 8 illustrates in part perspective view a preferred form of opening device for a container lid using a frangible element similar to that shown in Fig. 7; and

Fig. 9 illustrates in fragmentary cross-section view the container lid shown in Fig. 8 being opened.

In Fig. 1 is shown a lid 10 of, for example, a container made of sheet metal having a weakened line 12 made by scoring or partially cutting through the metal in accordance with a previous method.

Fig. 2 illustrates the dies used to make the scored line 12 in Fig. 1. The sheet metal lid 10 is located between a scoring tool 14 and an anvil 16 with the sharp edge 18 of the scoring tool 14 entering into the sheet metal. Penetration of the metal by the scoring force 20 is resisted by compressive stresses 21 in the top portion of the metal. The displaced metal forms inclined surfaces of the top of the metal on each side of the scoring tool resulting in unbalanced stresses between the top and bottom surfaces of the metal so causing failure in the form of cracks 22.

In Figs. 3, 4 and 5 there is shown in accordance with the present invention an article and a method and apparatus for making it, the article comprising a sheet metal container wall 26, in this instance a tinplate lid, having a weakened line or frangible element 24. The frangible element 24 surrounds a tear-open panel and is, in this example, annular in plan. The frangible element 24 is in the form of a thinned portion of the metal constituting an area of thickness smaller than the general, substantially uniform, thickness of the container wall 26.

As shown in Figs. 4 and 5 the annular frangible element 24 is made by pressing an annular portion of the metal which with an annular bead 30 bounds a central area 32 of the lid 26. The lid which has a rim 34 before making the weakened line, is shown in almost open press tool dies in Fig. 4. The dies are made from suitable tool material and they comprise a top die 36 and a bottom die 40. The dies 36 and 40 are generally circular. A part of the left-hand side only of the dies is shown in Figs. 4 and 5 along a radial section line. The shape towards the centre of the dies may be modified as shown in Fig. 6 subsequently described.

Top die 36 has a flat surface 42 comprising two concentric areas 42*a*, 42*b* separated by a projection in the form of a bead 47. The top die has a raised stepped edge portion 44 including a rounded step 46 and a flat surface 48. The step 46 has rounded edges 49, 49^1 where it joins the surfaces 42*b*, 48. Such steps between the curved or rounded edges may be perpendicular to the surfaces they join or inclined to them. Surfaces 48 and 42*b* which are parallel comprise respectively top and bottom work-contacting surfaces for the top die separated by the rounded step 46 and surrounding a central area of the die.

Bottom die 40 comprises a rim portion 50 and a flat portion 52 constituting a work-contacting surface which extends inwardly of rim portion 50 to an edge or step 56 from whereon the bottom die is relieved to allow downward displacement of the sheet material. In detail, adjacent flat portion 52 is provided a stepped portion 54 and a recess 60. The stepped portion 54 comprises a rounded step 56 and a ledge 58 underlying the flat surface 42*b* of top die 36. Step 56 joins surfaces 52, 58 through rounded edges 59, 59^1. Ledge 58 comprises a further (bottom) work-contacting surface for the bottom die separated by the step 56 from the (top) work-contacting surface 52 and with it surrounding a central area of the bottom die. Flat portion 52 and ledge 58 are parallel to each other and to surfaces 48 and 42*b*. Adjacent to the ledge 58 of stepped portion 54 is provided the recess 60. It will be observed that the bead 47 of the top die is opposite the recess 60, i.e. at a position to register with the recess for the purpose subsequently explained.

The step 46 and the surface 42*b* in the top die and the surface 52 in the bottom die form first opposed die parts which cooperate to form a rounded formation to one side of the frangible element in the sheet material and the projecting bead 47 and the recess 60 second die parts which co-

operate to form an indentation in the sheet material. It should be understood that the designations "top" and "bottom" in relation to the dies described and claimed herein are not intended to indicate that one die will always be used vertically above the other. Any suitable orientation of the dies may be used. The designations "top" and "bottom" in relation to the surfaces of the sheet metal should be similarly understood.

Referring to Fig. 4, as the top die 36 moves towards the bottom die, the bead 47 initiates a deformation in the sheet metal in the shape of a shallow curve at the point where the bead impinges on the metal. Subsequently in the single step pressing operation, as the dies close further, (Fig. 5) the top die 36 co-operates with the bottom die 40 to complete the formation without substantial variation in the thickness of the material, of the substantially part-circular bead 30 from this deformation and to displace parts of the sheet metal to different planes and to form a thinned portion 24 or frangible element between work-contacting surfaces 42*b* and 52. It will be seen that a part of the top surface of the material is displaced by the dies towards an opposite side of the sheet and a part of the bottom surface of the sheet is displaced in the same direction. Edges 64, 66 of the two displaced parts are separated with the thinned portion 24 in between. A downward formation in the shape of a rounded step 64 is produced in the top surface of the sheet leading from a first portion 65 of the sheet to the thinned portion 24 which is in a plane parallel to the first portion 65 and of smaller thickness than the said portion. A downward formation or depression in the shape of a rounded step 66 is also formed in the bottom surface of the sheet leading from the thinned portion to a second portion 67 of thickness greater than the thinned portion. In this second portion is the indentation 30. The outer surface of the indentation 30 (i.e. the longer surface) is in the same surface of the material as the rounded step 66 which is on the same side of the frangible element, as the indentation. Steps 64 and 66 are formed in the same direction and are spaced from each other with the frangible element 24 between them. These steps correspond to the step 46 in the top die and the step or edge 56 in the bottom die, which, as shown, are spaced apart in the closed position of the dies.

In the pressing operation, the bead 47 of top die 36 presses the sheet metal of the lid 26 into recess 60 of the bottom die 40, drawing metal down into the recess while a portion of flat surface 42*b* of top die 36 compresses and thins the sheet metal against the flat portion 52 of bottom die 40 over the area of overlap between these two work-contacting surfaces. The thinned area comprises the weakened line or frangible element 24 its edges being defined by steps 64 and 66. Step 66 lies inwardly of step 64 substantially parallel thereto. The width of the frangible element 24 is substantially constant and is greater than its thickness. The steps are annular in form as is the frangible element. The formation of the thinned portion 24 and the bead 30 may be considered as an inward extrusion of the material between the dies, the final shape of which is controlled by the shape of the dies. The inward movement of the material is facilitated by the rounded edges 49, 49¹, 59, 59¹ of the steps in the dies which assist the flow of the material. This flow of material and the means for producing it are quite different from scoring as above described and are also quite different from semi-shearing in which metal is partially cut through or sheared by use of sharp cornered tools, which moreover do not compress a portion of metal to thin it.

Referring to Fig. 3, the metal sheet in the region of the extrusion is seen to have on the top surface first and second surface elements *a* and *b* in different planes joined by a step 64 (corresponding to the top die surfaces) and a curved surface element *c* adjacent the second said element directed away from the plane of the first element *a*. On the bottom surface the metal sheet has (corresponding to flat portion 52 of the bottom die) a plane surface element *d* opposite the first surface element *a* and the step 64 and also opposite at least part of the second surface element *b* and a curved surface *e* opposite and substantially parallel to the curved surface *c* on the top surface of the sheet, the distance between the first surface element *a* and the plane surface element *d* exceeding the distance between the second surface element *b* and the plane surface element *d*. The plane surface element *d* joins the lower curved surface *e* by a step 66 directed away from the plane of the second surface element *b*, and a ledge *f*. Drawing the sheet metal to form bead 30 from the area of the frangible element 24 assists in accommodating the excess metal which freely flows inwardly in the dies from the thinned area to produce a deformation in the lid in a controlled manner. If the deformation was not initiated by the projection in the die 36, there would be a danger of it taking place at random across the lid producing undesired buckling.

While it is not desired to be bound by theory it is believed that the compression stresses 68 (Fig. 5) are equally balanced between the top and bottom surfaces of the sheet metal so the displaced metal can flow in equilibrium between the dies into the bead 30 without any or with reduced risk

of work hardening the thinned metal so avoiding or reducing the risk of cracking. The method and apparatus facilitate the production of a consistently accurate depth of residual material in the lid or other container wall which ensures that this can always be readily and easily opened by the user by use of suitable means, e.g. as subsequently described. The residual thickness is preferably less than half the general lid thickness. For tinplate lids 0.009 ins. thick the residual material is preferably approximately one third this thickness, i.e. 0.003 ms. thick. The residual depth can be varied according to the characteristics of the material.

Repeatable accuracy of depth of the frangible element is obtained over very large production runs as the flat work-contacting surfaces maintain their shape and form. This overcomes the disadvantage arising from prior art scoring processes where constant impact of the scoring tool on the anvil causes the tool to become blunt.

Referring now to Fig. 6 there is shown a section through dies and a lid generally similar to the dies shown in section in Fig. 5, like parts being indicated by like numerals. The section is taken along a line where upstanding triangular shaped ears 70 for use subsequently as securing means have been formed in the central area 32 of the lid 26 prior to its entry into dies 36, 40. The triangular shaped ears extend generally parallel to the rim 34 of the lid 26 preferably along an arcuate line inwardly of and parallel to a part of the circumference of the lid. The ears have a channel 72 between them which is intended to receive fixing tabs of a handle used in opening means for the container. A recess 74 in top die 36 provides a clearance right round the lid to clear channel 72 and a bead similar to bead 116 subsequently described with relation to Fig. 8.

In the present example it is convenient to form the ears 70 in the blank prior to making the frangible element to avoid breaking the element in a subsequent forming operation. The ears may be used to make a folded connection 76 described later in relation to Fig. 8 by placing tabs 78 of an opening device 80 into the channel 72 and bending down the ears over the tabs while holding the remainder of the lid in suitable clamps.

In Fig. 7 is shown a form of reinforcement for a can end made, for example, of tinplate formed adjacent a thinned weakened portion or frangible element 98. A lid 84 has in the base of its rim 86 a reinforced edge 88 comprising two layers of material overlying the material 89 adjacent the thinned portion 98, the layers being joined to each other and to the material 89 through reversed bends 90 and 92. Bend 90 provides adjacent one of the rounded steps 96 which bounds the thinned portion a shoulder 94 against which can be broken an edge 97 of the thinned portion. Shoulder 94 also provides a safe edge for the inside of the container when the removable portion 100 of the lid has been removed. A bead 102 is provided as previously explained.

In Fig. 8 is shown a preferred form of opening device for opening a lid of a container. A handle 118 is secured to a tear open portion 105 of the lid 106 bounded by a frangible element 112 whereby the frangible element may be ruptured and the tear open portion lifted from the wall. In the figure, a container body 104, a lid 106 and an opening device 80 are all preferably made from tinplate although other materials such as aluminium can equally well be used. Lid 106 is joined to body 104 by a seamed joint 108. Use of tinplate for both body and lid is advantageous from the point of view of cost. Lid 106 is provided with a reinforced shoulder 110 similar to shoulder 94 above described and a thinned portion or weakened line 112 to provide a frangible element which is formed in a manner similar to that above described. A folded connection 76 provided in the material (see also Fig. 6) secures tabs 78 of the opening device 80 to the lid. The folded connection may be made by clenching downwardly triangular shaped ears formed in the blank prior to pressing the weakened line as above described with reference to Fig. 6. The lid has an annular bead 114 similar to the beads 30 and 102 previously described in relation to Figs. 3 and 7, and a stiffening bead 116.

The opening device 80 comprises a tab handle 118 including a ring and a stiffening bead 120 provided with a nose portion integrally connected to tabs 78 by a hinge portion 124. In the initial inoperative position of the tab handle in which it lies substantially parallel to that of the lid, the nose portion 122 is located above and inwardly of the thinned portion or frangible element 112 spanning the bead 114. The nose portion 122 is reinforced by folding corners 126 over hinge portion 124 as shown in Fig. 8. Slits 128 one each side of bead 120 allow bead 120 to be lifted by handle 118 so that the hinging can take place and the overlying corners 126 serve to prevent tearing of the metal along the lines of slits 128 beyond the edges 130 as the handle 118 is lifted. The reinforcement which the corners 126 provide does not increase the overall height of the opening device and therefore allows the container lids with their opening devices to be nested prior to assembly on container bodies.

In Fig. 9 the handle 118 is shown lifted

to its operative position with nose portion 122 hinging downwardly and breaking through or puncturing a portion of the frangible element 112 so as to bend down an underlying portion 113 of the lid. The handle with its securing means is then upwardly pulled out of the original plane of the lid to fracture through on each side of the initial puncture the remainder of the frangible element 112 against the shoulder 110 so lifting and removing the portion 105 of the lid inwardly of the element 112 from the container. It will be understood that this preferred process is different from the action in tear-off containers previously proposed in which a scored line is progressively torn through to peel off from the container a removable portion of the lid which bends appreciably in the process.

In opening means using a frangible element made by the means herein described, a handle may be secured to a removable portion of the container wall by means other than those above described, e.g. by rivetting, welding or other securing means.

Thinned portions in accordance with this invention may be made to completely surround the lid or wall of a container or a portion thereof in the form of a circle or other suitable closed figure, or, if desired, may only partly surround part or the whole of a lid which can then be bent away from or into the container after fracturing the thinned portion.

The fracturing need not be carried out by handle means and the method and apparatus of this invention are intended for use in the manufacture generally of frangible elements in container walls however these may be utilised.

WHAT WE CLAIM IS:—

1. Sheet material having a first portion, a downward rounded formation in the top surface of the sheet leading to a frangible element comprising material of smaller thickness than the first portion, a downward rounded formation in the bottom surface of the sheet leading from the frangible element to a second portion of thickness greater than that of the frangible element, there being a hollow deformation in the second portion.

2. Sheet material according to claim 1 wherein the hollow deformation is an indentation in the material of substantially uniform thickness with the first portion and the second portion.

3. Sheet material according to claim 1 or 2 wherein the hollow deformation is in the form of a hollow bead close to the frangible element.

4. Sheet material according to claim 3 wherein the bead is of part circular cross section.

5. Sheet material according to any one of the preceding claims wherein the hollow deformation or bead is downwardly formed.

6. Sheet material according to any one of the preceding claims wherein the first and second portions are of substantially uniform thickness, each downward formation being in the form of a rounded step in the surface of the material, the two steps defining the frangible element which is of a thickness less than said uniform thickness.

7. Sheet material according to any one of the preceding claims wherein the frangible element has a thickness less than one half that of the first and second portions which are of uniform thickness.

8. Sheet material according to any one of the preceding claims having a shoulder adjacent the downward formation or step leading from the first portion.

9. Sheet material according to claim 8 wherein the shoulder comprises at least one layer of the sheet material overlying a part of the sheet material adjacent the downward formation or step.

10. Sheet material according to claim 8 wherein the shoulder comprises two layers of the sheet material in the form of a pair of reversed folds overlying a part of the sheet material adjacent the downward formation or step.

11. Sheet material according to any one of the preceding claims wherein each downward formation or step forms a closed figure in the sheet surrounding the second portion, one downward formation or step lying inwardly of the other and substantially parallel thereto, the downward formation or steps bounding a frangible element of substantially constant width.

12. Sheet material according to claim 11 wherein the width of the frangible element exceeds its thickness.

13. Sheet material according to claim 11 or 12 wherein the downward formations or steps and frangible element are annular in plan.

14. Sheet material according to any one of the preceding claims wherein the material is plated material.

15. Sheet material according to claim 14 wherein the material is tinplate.

16. A container wall formed of sheet material according to any one of the preceding claims wherein the frangible element forms a part of opening means for the container.

17. A container wall according to claim 16 having a handle secured to a tear open panel of the sheet bounded by the frangible element whereby said frangible element or portion may be ruptured and the tear open panel lifted from the wall.

18. A container wall according to claim 17 wherein the handle is hinged to allow

initial downward puncture of the frangible element on lifting the handle.

19. A method of forming a frangible element in sheet material comprising pressing a portion of the material to thin it between press tool dies in a single step pressing operation to form a first rounded formation in one surface of the material, a frangible element consisting of thinned material, the first formation joining the frangible element to a first portion of greater thickness than the frangible element, excess material from the thinned portion passing into a second portion of greater thickness than the frangible element on the other side of the frangible element from the said first portion, and a second rounded formation in the material joining the frangible element to the second portion, and simultaneously acting on the material of the second portion, without causing substantial variation of the thickness, to form a hollow indentation in the material.

20. A method according to claim 19 wherein each of the said formations is formed as a rounded step.

21. A method according to claim 19 or 20 wherein the hollow indentation is a hollow bead close to the thinned portion.

22. A method according to any one of claims 19 to 21 wherein the formation of the hollow indentation is initiated before the dies begin to compress material to form the thinned portion, the formation of the indentation being continued as the thinned portion is formed.

23. A method according to any one of claims 19 to 22 wherein the indentation is formed on the same side of the frangible element as the rounded formation which is in the same surface of the material as its inner surface.

24. A method according to any one of claims 19 to 22 wherein the portion which is subjected to the pressing operation is closed in plan and the indentation is formed inwardly of it in plan.

25. A method according to any one of claims 19 to 24 wherein the sheet material is tinplate.

26. A method according to any one of claims 19 to 25 wherein the thickness of the frangible element formed is less than one half of the initial thickness.

27. A method of making a frangible element in sheet material by pressing it between press tool dies in a single step pressing operation wherein the material is acted on by the dies to displace a part of one surface of the material towards the opposite side of the sheet and to displace in the same direction a part of the other surface of the sheet, the edges of the two displaced parts being spaced from one another and being downward rounded formations, one in each surface of the material, and in the pressing operation a portion of the material between the said edges is compressed by the dies to form a thinned portion constituting the frangible element, excess material being allowed to flow into a portion to one side of the frangible element, the dies simultaneously acting on the material of the portion, without causing substantial variation in the thickness, to form a hollow indentation in the material.

28. Press tooling for forming a frangible element in sheet material including top and bottom press tool dies, having first opposed diep arts having a rounded formation in one of the dies whereby sheet material pressed between the dies in a single step pressing operation has formed therein a frangible element consisting of thinned material and adjacent the frangible element on one side a rounded formation in one surface of the material, the dies being of a shape to create adjacent the frangible element on its other side a rounded formation in the other surface of the material, and of a shape to allow, during pressing of the sheet material, excess material to pass into a portion of greater thickness than the frangible element to the said other side of the frangible element, and second die parts comprising a projecting part and a recessed part which, during the pressing of the material can act upon the material of the said portion without causing substantial variation in the thickness of the material, to form an indentation in the material.

29. Press tooling according to claim 28 wherein the first and second die parts are arranged so that the second die parts engage the sheet material to begin formation of the indentation before the first die parts begin to press the material.

30. Press tooling according to claim 28 or 29 wherein the first die parts are of continuous plan surrounding an area, and the second parts are in plan within the said area.

31. Press tooling according to claim 28 to 30, wherein the first opposed die parts are such that the thickness of the frangible element after the pressing operation is not more than one half of the initial thickness of the material.

32. Press tooling according to any one of claims 28 to 31 wherein the rounded formation is a rounded step, and there is a rounded step in the other die whereby the rounded formations in the sheet material are rounded steps.

33. Press tooling according to any one of claims 28 to 32 wherein the projecting part is in the form of a bead, the recessed part being opposite the bead.

34. Press tooling according to any one of claims 28 to 33 wherein the projecting

part or bead is in the same die as the said rounded formation in the first die parts.

35. Sheet material having a frangible element substantially as herein described with reference to and as shown in Fig. 3, 5, 6, 7 or 8 of the drawings accompanying the Provisional Specification No. 4248/69.

36. A container wall substantially as herein described with reference to and as shown in Fig. 3, 5, 6, 7 or 8 of the drawings accompanying Provisional Specification No. 4248/69.

37. A method of making a frangible element in sheet material according to claim 19 or 27 substantially as herein described with reference to and as shown in Figs. 4 and 5 or Fig. 6 of the drawings accompanying Provisional Specification No. 4248/69.

38. Press tooling substantially as herein described with reference to and as shown in Figs. 4, 5 or Fig. 6 of the drawings accompanying Provisional Specification No. 4248/69.

39. Sheet material having a frangible element made by the method of any one of claims 19 to 27 and 37.

40. Sheet material having a frangible element made by use of press tooling according to any one of claims 28 to 34 and 38.

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1262272 PROVISIONAL SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig.1.

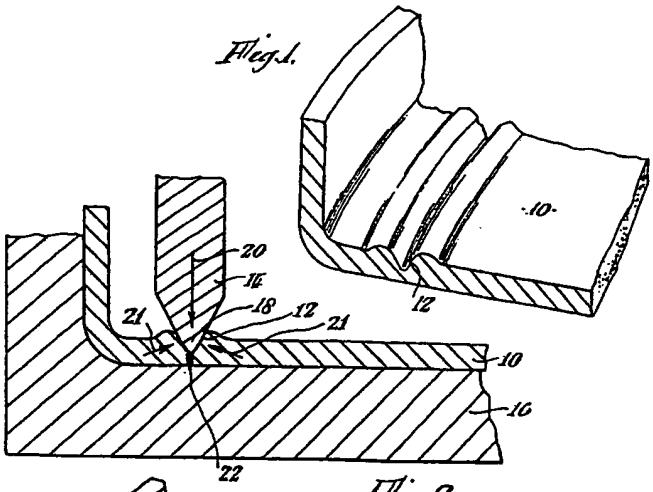


Fig.2.

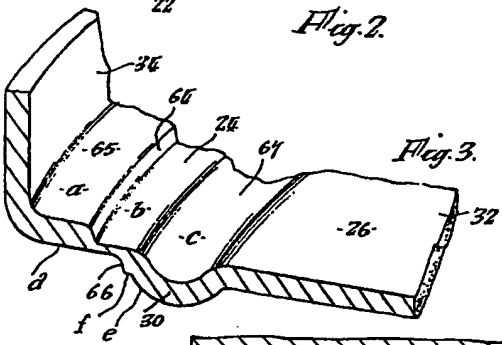


Fig.3.

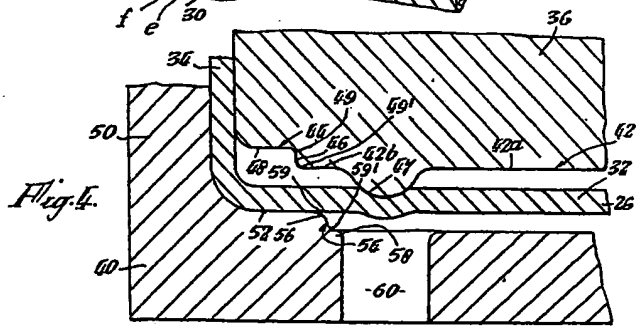
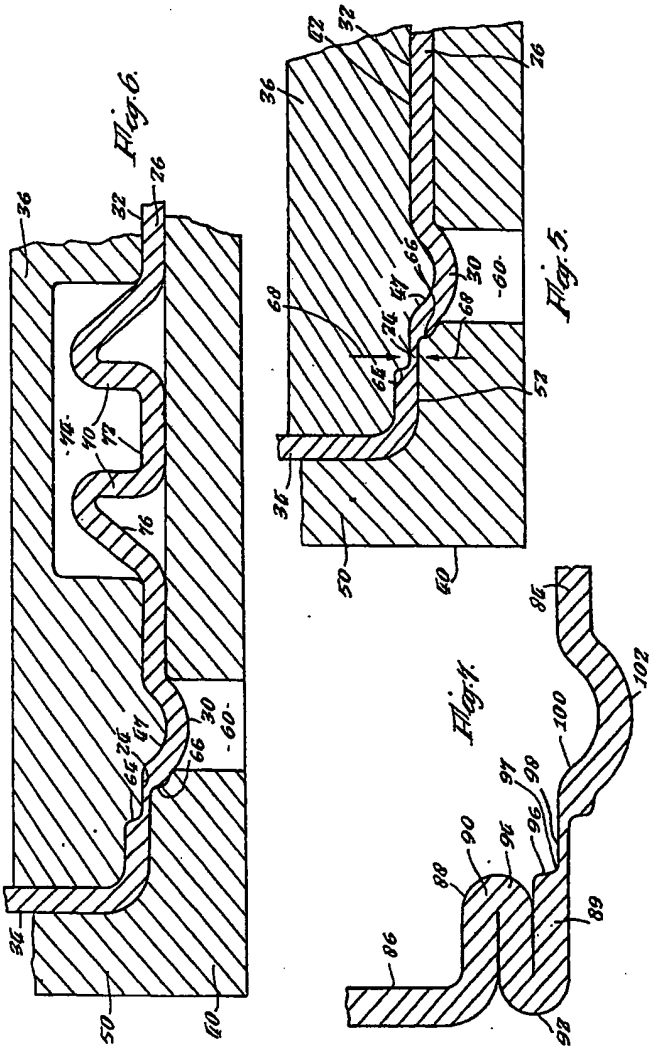


Fig.4.

1262272 PROVISIONAL SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2



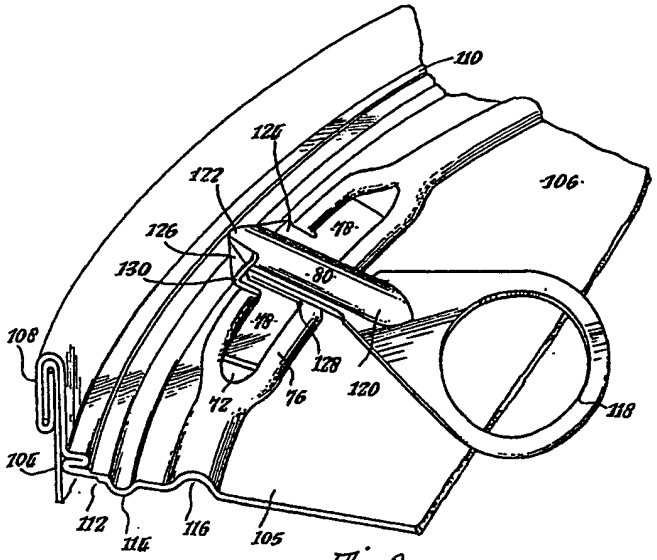

110
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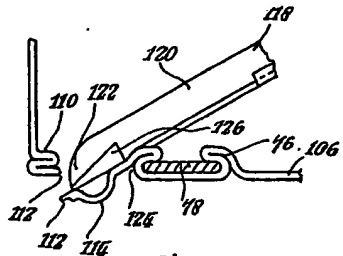
Fig. 8.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78

Fig. 9.